Mortality of large trees: a critical process in biomass cycle in Neotropical Forests

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Scientific challenge

- Tropical forests harbor a vast amount amount of carbon

- Amazon basin estimates of biomass ranged from 39 to 93 Pg C, with a mean value of 70 Pg C (Houghton *et al.* 2001)

- Changes in tropical forest carbon cycling will affect the pace of climate change (Clark 2004)

Urgent need to understand how tropical forests are responding to the ongoing changes

Recent findings in the Neotropics

Significant changes in the structure and dynamics of Neotropical forests:

- Increase in AGB in the neotropical forests (Phillips *et al.* 1998, 2002, Baker *et al.* 2004)

- Increase in recruitment and mortality rates in Amazonia (Phillips *et al.* 2004)

Potential driver:

- an increase in atmospheric concentration of CO_2 (Lewis *et al.* 2004)

Changing dynamics of tropical forests (Malhi Grace 2000)

Major sources of uncertainty

- difference in measurment protocols used among plots (Clark 2004-2007)
- forests regenerating from past disturbances (Wright 2005-2006)
- plots size → contrasting results on large plots (Chave 2003, Feeley 2007)
  → 51 out of 59 plots of the RAINFOR project are ≤ 1ha
- plots size → «clustered disturbance» or «rare mortality events» biases
  (Fisher 2008, Körner 2004)

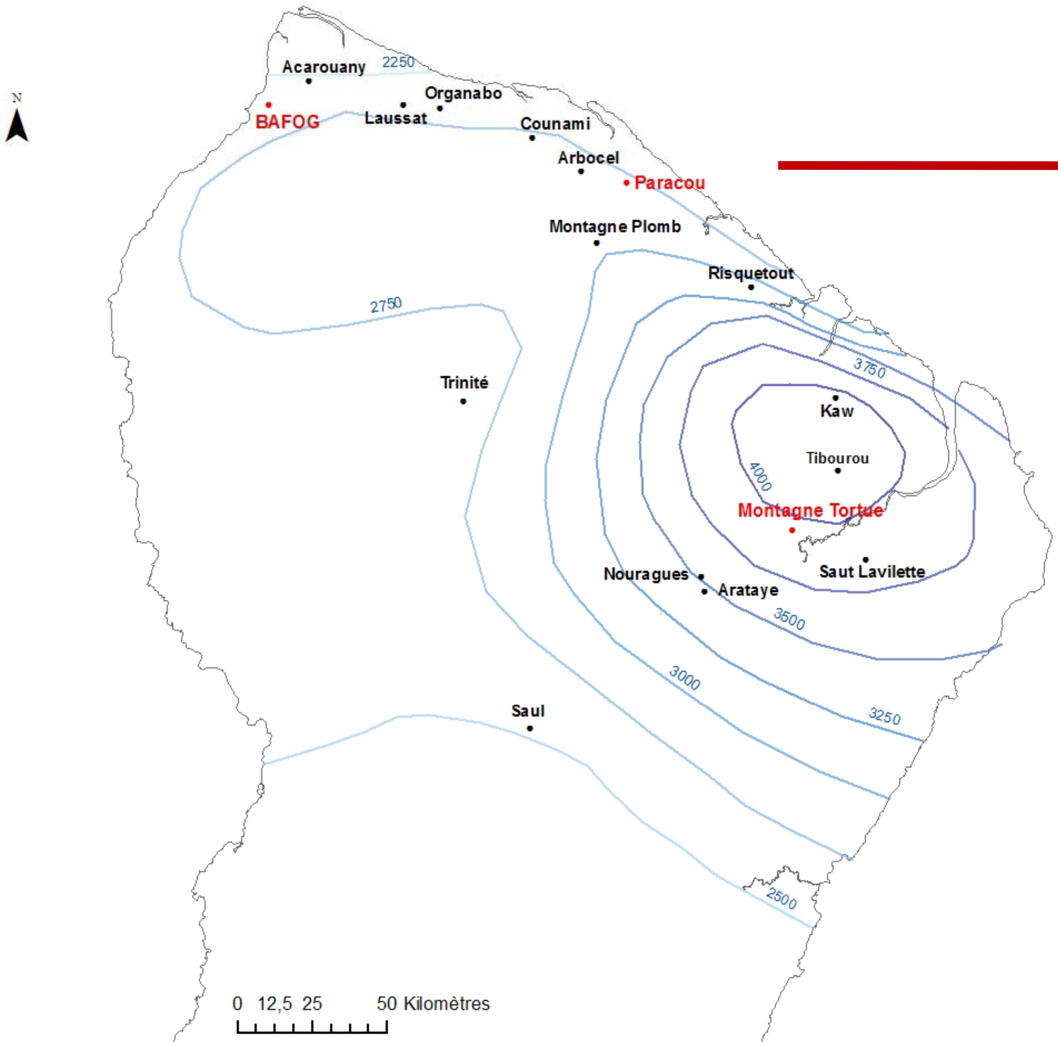
Strong need to better assess the AGB cycle

Questions

- How does vary the AGB at our site? Does the biomass dynamic reflect the same trend as the one observed in Amazonia ?

- How does biomass vary at scale larger than 1ha ?

Site location



PARACOU

100ha of « terra firme »
6 x 6,25ha plots
rainforest
27’753 trees
measured every 2 years
Part of the GUYAFOR
network

2 sets of plots:
1984-2007: plots 1,6 & 11
1991-2007: plots 13,14 &15

Materials and methods

Biomass is calculated following Chave *et al.* 2005 equation for moist forest stands:

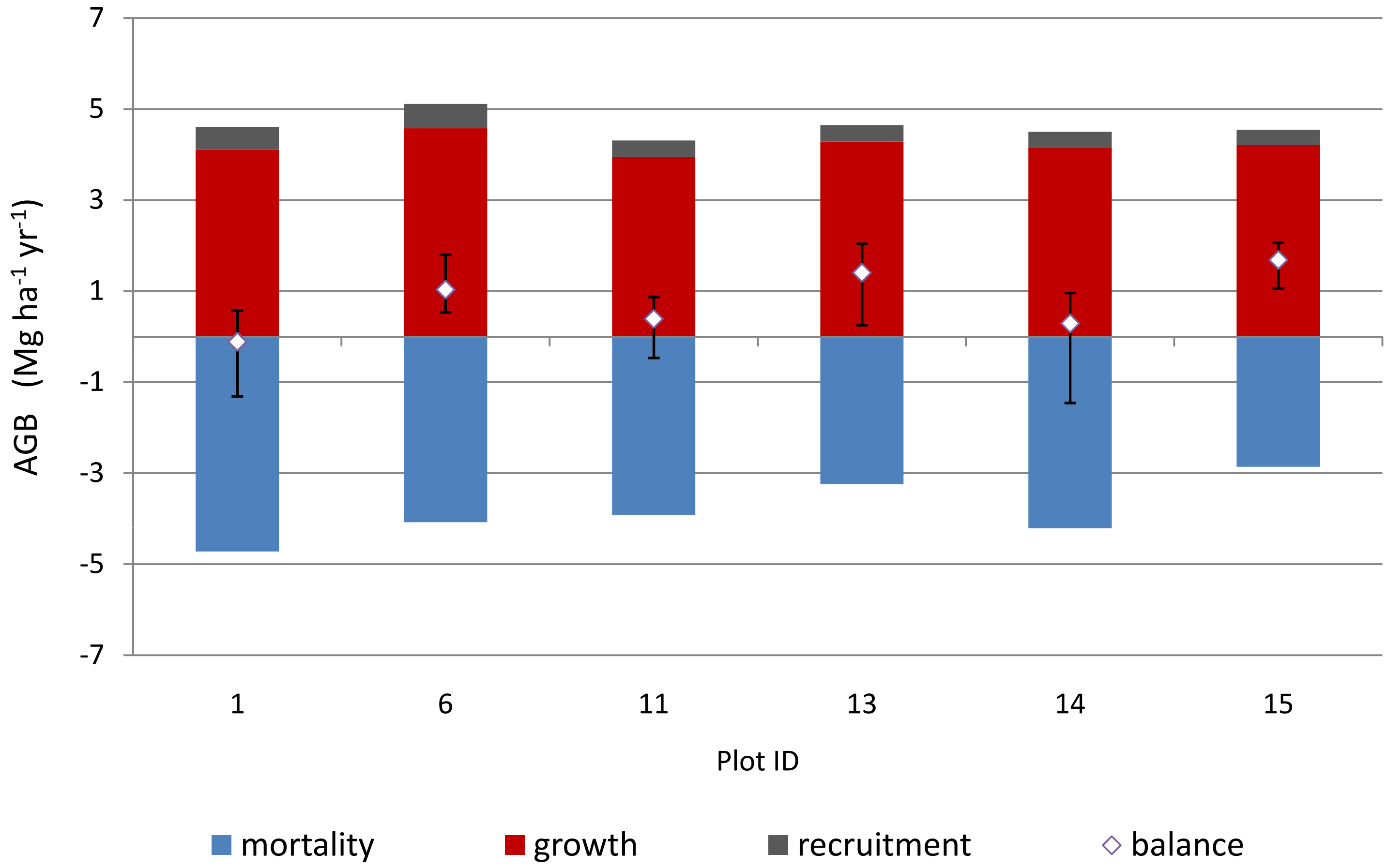
$$\mathbf{AGB = wsg \times exp(-1.499 + 2.148 ln(dbh) + 0.207 (ln(dbh))^2 - 0.0281 {*} (ln(dbh))^3)}$$

dbh = diameter at breath height (1,3m) for all trees dbh ≥ 10cm
wsg = wood specific gravity (g/cm^3)

Flux in (growth & recruitment) → Δ AGB → Flux out (mortality)

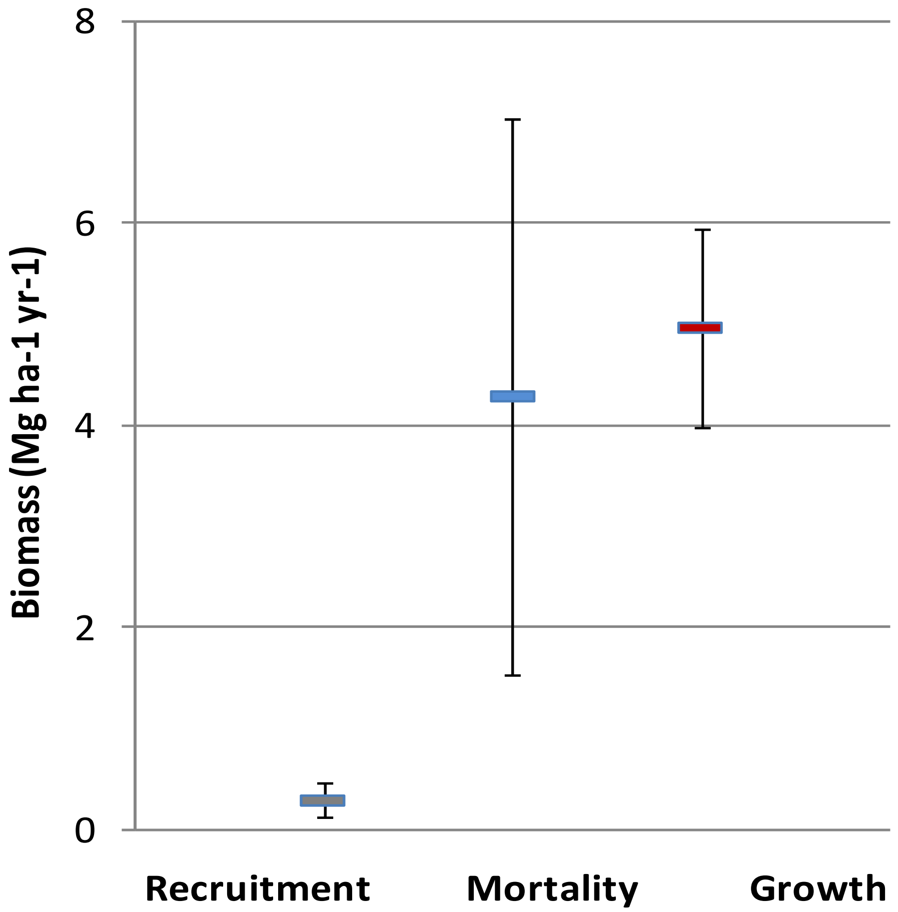
$$\Delta AGB = AGB_{growth} + AGB_{recruitment} - AGB_{mortality}$$

Above-ground biomass balance



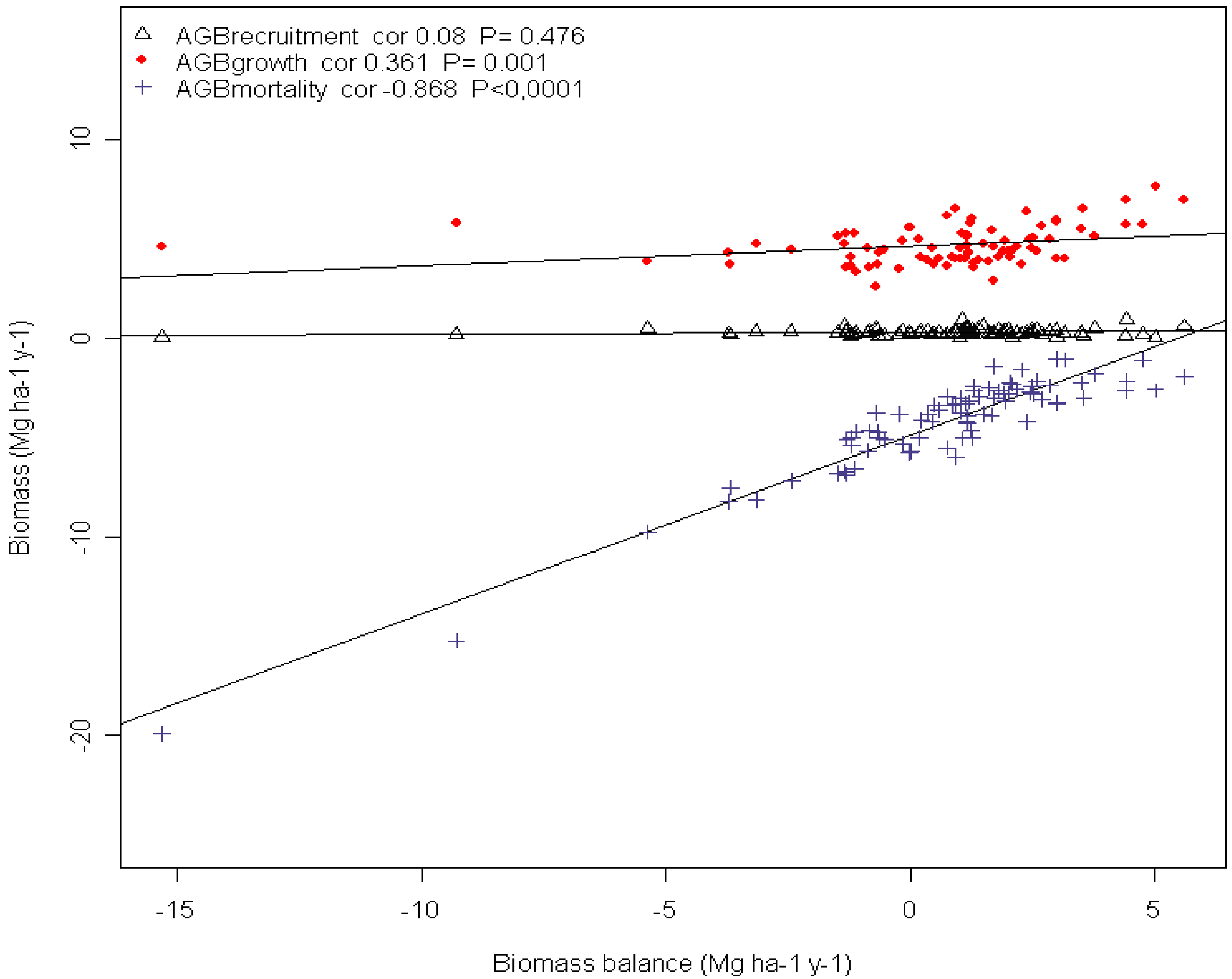
→ 50% of our plots show a significant increase in biomass

Standard deviation within each flux



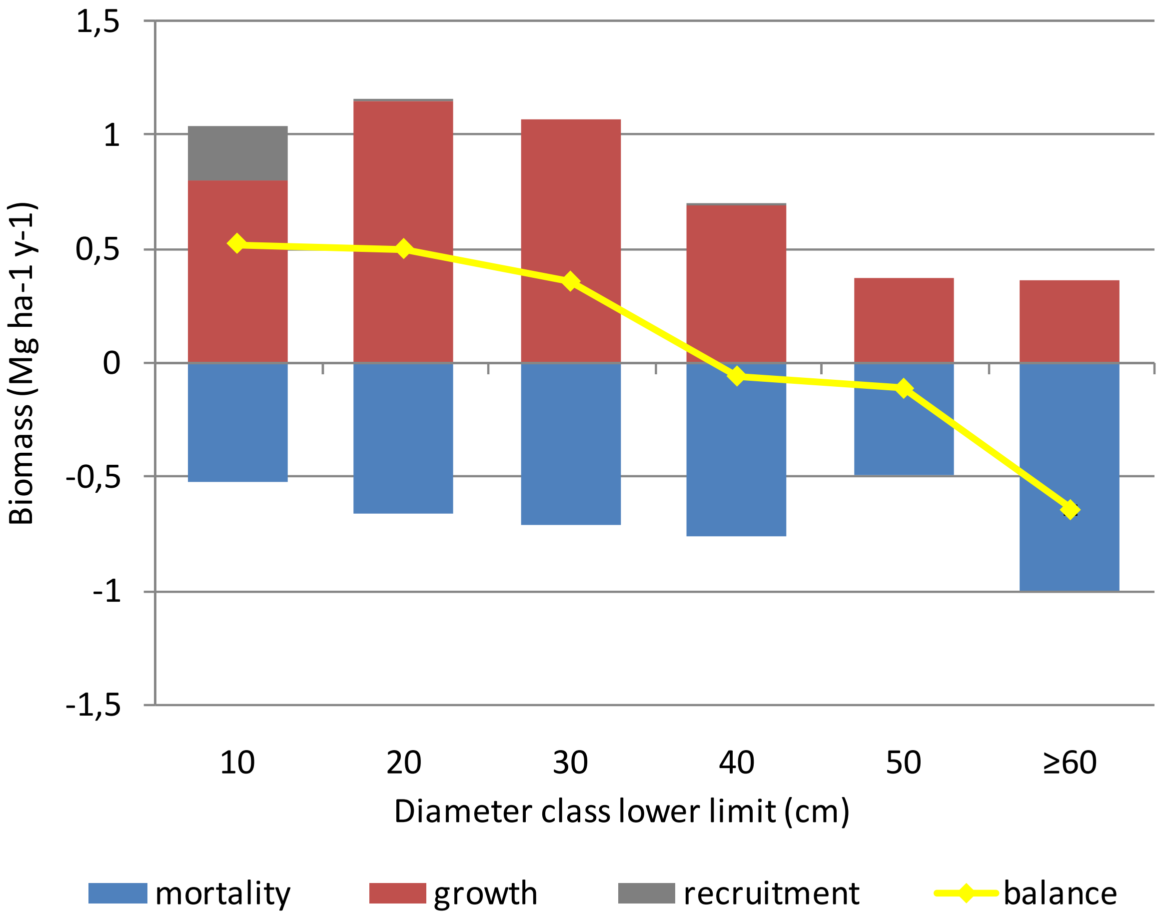
→ **large variation in the amount of biomass lost**

Contribution of the each flux to the balance of biomass



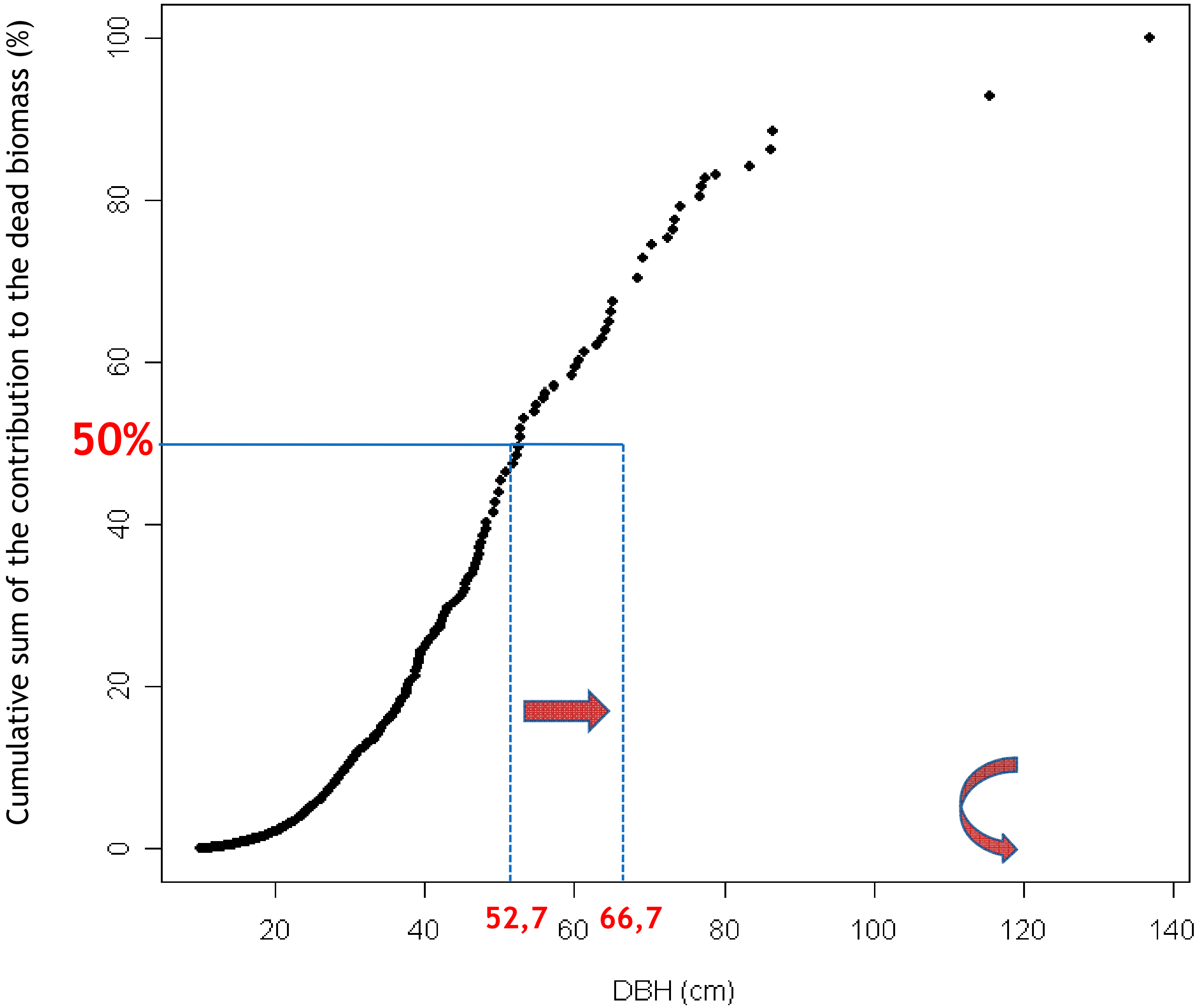
→ dead biomass is a major driver in the variation of biomass balance

Variation of the biomass balance among size-classes



→ biomass balance decrease with increasing diametre size-class

Change in dead biomass with plot size



→ **increasing contribution of large dead trees as plot size augment**

Conclusion

- Strong local variability in AGB dynamic at local scale (~40ha)
- Mortality of large trees (≥40cm dbh) is a main driver in AGB balance variations
- Our findings suggest that plot size is critical in assessing AGB dynamic, as mortality of large trees is rare in both time and space

Thank you for your attention